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APPLICATION FOR UNITED STATES LETTERS PATENT

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FOR: BLOWBY GAS CIRCULATION SYSTEM AND THE METHOD OF CIRCULATION

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TITLE OF THE INVENTION

BLOWBY GAS CIRCULATION SYSTEM AND THE METHOD OF CIRCULATION

BACKGROUND OF THE INVENTION

1. Field of the invention

The present invention relates to a blowby gas circulation system for a drysump lubrication type engine and a method of circulating blowby gas.

2. Discussion of background arts

Japanese Patent Application Laid-open No. Toku-Kai-Hei 11-148333 discloses a technology of a blowby gas circulation system for a drysump lubrication type engine. Specifically, in the blowby gas circulation system, a mixture of liquid (engine oil) and gas (blowby gas generated in a crankcase) is introduced to a breather chamber and the separation of gas from liquid is performed therein. The separated blowby gas is introduced to an intake system of the engine and the separated oil is returned to the crankcase. Further, the liquid and gas mixture in an oil tank is introduced to the breather chamber and the aforesaid separation of gas from liquid is performed.

However, according to the aforesaid prior art, since the greater part of the liquid and gas mixture in the crankcase is guided directly to the breather chamber, in case where the amount of the liquid and gas mixture exceeds a capacity of separating gas from liquid, the separation of gas from liquid

can not be effectively performed. As a result, the liquid and gas mixture blows out from the breather chamber and engine oil flows out to the intake system and an adverse effect is brought to an air cleaner and the like.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide an engine in which gas and liquid are effectively separated from a gas-liquid mixture generated in the crankcase and engine oil is prevented from flowing out to an intake system of the engine.

To attain the object, a blowby gas circulation system comprises an oil tank for supplying engine oil reserved therein to a crankcase and for introducing a gas-liquid mixture generated in the crankcase and for separating the gas-liquid mixture into gas-liquid mixture and engine oil, a first breather chamber for introducing the gas-liquid mixture and for separating the gas-liquid mixture into gas-liquid mixture and engine oil and for returning the engine oil to the crankcase and a second breather chamber for introducing the gas-liquid mixture and for separating the gas-liquid mixture into blowby gas and engine oil and for sending the blowby gas to an intake system and for returning the engine oil to the crankcase.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a perspective view showing a drysump

lubrication type engine incorporating a blowby gas circulation system according to an embodiment of the present invention;

Fig. 2 is a sectional view showing an inside of the engine;

Fig. 3 is a side view of the engine;

Fig. 4 is a schematic view showing a blowby gas circulation system according to the embodiment of the present invention;

Fig. 5 is a rear view of a clutch cover of the engine;

Fig. 6 is a front view showing a gasket of the engine;

Fig. 7 is a front view showing a second crankcase of the engine; and

Fig. 8 is a front view showing a first crankcase of the engine.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to Figs. 1, 2 and 3, an engine 1 is mainly constituted by a cylinder case 2, a cylinder head 3, a cylinder head cover 4, a crankcase 5 and an oil pan 6. The cylinder head 3 has a combustion chamber 7 and the cylinder case 2 has a cylinder in which a piston 8 is reciprocatably accommodated. The cylinder head 3 has an intake and exhaust ports 9a, 9b and an intake and exhaust valves 10a, 10b for opening and closing the intake and exhaust ports 9a, 9b, respectively. The intake and exhaust valves 10a, 10b are driven by two camshafts 12a, 12b constituting a part

of a cam mechanism 11, respectively. The crankcase 5 is formed by integrally connecting a first crankcase 5a with a second crankcase 5b. A crankshaft 13 supported by the crankcase 5 is connected with a connecting rod 14 for transforming a reciprocating motion of the piston 8 into a rotational motion and transferring the rotational motion to the crankshaft 13.

The first crankcase 5a incorporates a transmission mechanism 15 having a main shaft 16 on which drive gears are mounted and a counter shaft 17 on which driven gears meshing with the drive gears are mounted. The crankshaft 13 transmits power to the main shaft 16 and the main shaft 16 transmits power to the counter shaft 17. A clutch unit 18 is mounted on the main shaft 16 and is covered by a clutch cover 20 attached to the second crankcase 5b through a gasket 19.

On the other hand, a first oil pump (feed pump) 21 is integrally incorporated in the crankcase 5. When the first oil pump 21 is operated, as shown in Fig. 4, an engine oil O in the oil tank 23 flows through a first oil passage 24 and is introduced to the inside of the cylinder case 2, the inside of the cylinder head 3 and the inside of the crankcase 5 to lubricate primary parts of the engine 1.

According to an embodiment of the invention, as illustrated in Fig. 4, an engine oil O1 after lubrication returns to the inside of the crankcase 5 and is gathered to an oil basin 25 formed in the oil pan 6. The engine oil O1 gathered to the

oil basin 25 is introduced through a second passage 27 to an upper space 23a in the oil tank 23 by a second oil pump (scavenging pump) 26. The engine oil O1 fed to the upper space 23a of the oil tank 23 contains blowby gas generated in the crankcase 5, forming a gas-liquid mixture G1. When the gas and liquid mixture G1 passes through the upper space 23a in the oil tank 23, a first gas-liquid separation is performed. The engine oil separated by this first gas-liquid separation flows downward in the oil tank 23 and is reserved there. The pumping power (oil feeding capacity) of the second oil pump 26 is established to a larger value than that of the first oil pump 21.

After the first gas-liquid separation is finished, a gas-liquid mixture G2 passes through a third passage 28 and is guided into a first breather chamber 30 through an input port P1. The gas-liquid mixture G2 passes through the first breather chamber 30, a second gas-liquid separation is performed. An engine oil O1 separated in the first breather chamber 30 is discharged from an oil return hole 31 provided at the bottom of the first breather chamber 30 and is gathered in the oil basin 25.

After the second gas-liquid separation is done in the first breather chamber 30, a gas-liquid mixture G3 is introduced through a communication port 33 to a second breather chamber 32 provided adjacent to and independently from the first breather chamber 30. When the gas-liquid mixture G3 passes through the second breather chamber 32, a third gas-liquid separation is

performed. After the third gas-liquid separation is finished in the second breather chamber 32, an engine oil O2 is returned through a second oil return hole 34 and the first oil return hole 31 to the oil basin 25 and is reserved therein.

The gas-liquid mixture G3 after being subjected to the second gas-liquid separation in the first breather chamber 30 is separated into engine oil and a blowby gas BG containing little engine oil by a third gas-liquid separation in the second breather chamber 32. This blowby gas BG is discharged from the second breather chamber 32 to a fourth passage 29 through an output port P2 and is introduced to an air cleaner 40 of an intake system of the engine. Further, the blowby gas BG is introduced to a combustion chamber 7 of the engine 1 through the air cleaner 40, a carburetor 41 and an intake port 9a.

The first breather chamber 30 and the second breather chamber 32 are integrally formed with the crankcase 5. As shown in Fig. 5, the clutch cover 20 has a first pocket 30a on the back side thereof to constitute a component of the first breather chamber 30. The clutch cover 20 is connected with the second crankcase 5b through the gasket 19. as shown in Fig. 6, the gasket 19 has a first communication passage 30b at a position corresponding to a lower part of the first pocket 30a. Further, as shown in Fig. 7, the second crankcase 5b has a second pocket 30c at a position corresponding to the first pocket 30a of the clutch cover 20. The second pocket 30c has the first oil return hole 31 for

communicating between the second pocket 30c and the crankcase 5, the second oil return hole 34 for communicating between the first breather chamber 30 and the second breather chamber 32 and a second communication hole 30d for communicating to the communication port 33 of the second breather chamber 32. Further, as shown in Fig. 8, the first crankcase 5a has a third pocket 30e at a position corresponding to the second pocket 30c of the second crankcase 5b.

That is, when the clutch cover 20 is attached to the second crankcase 5b through the gasket 19, the first pocket 30a of the clutch cover 20 is superimposed on the second pocket 30c of the second crankcase 5b, thereby the first breather chamber 30 is formed. The first pocket 30a communicates with the second pocket 30c through the gasket 19. As a result, the gasket 19 serves as a labyrinth of the first breather chamber 30.

On the other hand, when the first crankcase 5a is connected with the second crankcase 5b, the second pocket 30c of the second crankcase 5b is superimposed on the third pocket 30e of the first crankcase 5a, thereby the second breather chamber 32 having a labyrinth is formed. The second pocket 30c communicates with the third pocket 30e through the second communication hole 30d and the communication port 33 and as a result the first breather chamber 30 communicates with the second breather chamber 32.

As described above, according to the embodiment, all of the gas-liquid mixture G1 generated in the crankcase 5 is

gathered in the upper space 23a of the oil tank 23. After the gas-liquid mixture G1 is subjected to the first gas-liquid separation, the gas-liquid mixture G2 is introduced to the breather chambers 30 and 32. That is, since the gas-liquid mixture G2 which has experienced the gas-liquid separation to some extent is introduced to the breather chambers 30 and 32, there is a small possibility that the gas-liquid mixture G2 as much as exceeding a capacity of gas-liquid separation is introduced. As a result, since the gas-liquid separation is effectively performed in the breather chambers 30 and 32, engine oil can be prevented from running out to the intake system.

Further, since the pumping power of the second oil pump 26 is established to a larger vale than that of the first oil pump 21, the inside of the crankcase 5 is kept in a vacuum condition with respect to the first breather chamber 30, thereby the engine oil O1 and O2 separated in the breather chambers 30, 32 are smoothly sucked into the crankcase 5.

Further, according to the embodiment, since the first and second breather chambers 30, 32 are integrally with the crankcase 5, the number of components of the blowby gas circulation system can be reduced.

The entire contents of Japanese Patent Application No. *Tokugan 2002-198354 filed July 8, 2002*, is incorporated herein by reference.

While the present invention has been disclosed in terms

of the preferred embodiment in order to facilitate better understanding of the invention, it should be appreciated that the invention can be embodied in various ways without departing from the principle of the invention. Therefore, the invention should be understood to include all possible embodiments which can be embodied without departing from the principle of the invention set out in the appended claims.